

Objections to Staff's Analyses of Impairments to Water Resources - Beaches (Tech Memo #3)

No.	Comment	Parties	Page #	Staff Response
54	Additional technical work is required to determine OWDS relationship to beaches via groundwater	For: City Latham & Watkins	155,162 470	Staff disagrees. See peer reviewer comments and response to peer reviews. See attachment #1 and attachment #3.. The microbiological and hydrological systems delivering bacteria to the beaches from the OWDSs are sufficiently complex that emerging information will provide more clarity, but will not disprove that under some conditions and in some places, OWDSs contribute pathogens to the beaches.
		Against: Baykeeper Surfrider Foundation	213-216	
55	Additional technical work is required to confirm EPA's criteria relating human illness to enterococcus despite natural sources of the bacteria	For: City	162	Staff disagrees. See response to peer reviewers comments and attachment #2 below. New criteria based on human source indicators will have the same problems as enterococcus, i.e. confusion due to transport in the food chain, large samples required to show statistical proof of human source indicators, and local variations in microbiological and hydrological conditions affecting the fate and transport of the indicator.
		Against: Heal the Bay Baykeeper Surfrider Foundation	235 216	
			241	
56	The scientific method was not followed in Tech Memo #3	For: City	162	Staff agrees that additional clarity can be provided. See changes in text and in peer review response attachment #1 on statistics. The use of frequencies to show enterococcus bacteria variations in populations of different sizes is a standard technical practice. The scientific process involves referenced journal articles, peer reviews, release of information to third parties and robust discussion.
		Against: Heal the Bay Baykeeper	235 216	
57	Technical memo #3 does not show relationship between OWDS and beaches	For: City WW Advisory Committee	155 186	Staff disagrees. See three independent peer reviewer comments. See historical and recent studies in Tech Memo 3. See staff analysis in peer review response attachment #1.
		Committee Colony Plaza	262	
		Latham & Watkins	470	
		Against: Heal the Bay Baykeeper Surfrider Foundation	235 213-216	
			241 316	

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58	Understanding groundwater transport of bacteria pollution can allow sufficient beach protection	For: City Colony Plaza Latham & Watkins	155,162 263 439	Staff concurs that the 6-month travel time area identified in Stone (2004) continues to indicate elevated risk for transport of bacteria into surface waters where the City of Malibu agreed in the 2004 Memorandum of Understanding to replace all OWDS within this zone. However, Stone (2004) is a hydrological study which did not include a literature search of microbiology in the groundwater or on beaches. The evidence for bacteria die-off and transport is significantly more complex than modeled by Stone (2004). Also see attachment #1 to this response to comments titled: <i>Interpretation of Temporal and Spatial Groundwater information</i> .
		Against: Heal the Bay Baykeeper Surfrider Foundation	235 213-216 241	Also see response to peer reviewers' comments on bacteria transport in groundwater. The City has not considered hydrological and microbiological factors which may increase or decrease bacteria transport and identification of bacteria in well tests. Staff's analysis of data (not released by the city previously) duplicates the City 's findings that stable groundwater levels are found in the Civic Center area. The City interprets this as steady and continuous discharge of groundwater at a rate sufficient to remove pathogens. However, staff notes that the well in the Civic Center area, such as the 'c' wells, have nondetect on some occasions and were found by Vergutz (2006) to contain bacteria. As numerous literature cited here suggests, the heterogeneity of the aquifer has a larger influence on virus transport than is considered in the City's work.
59	Site specific epidemiology studies relate illness to stormwater, not OWDSs	For: City	156,160, 162	Haile et. al. (1999) includes untreated urban runoff as a source, but does not exclude groundwater discharge from OWDS. It was not a source study so it identifies urban runoff as a source, but does not eliminate OWDSs as a source. It relates illness to a location on the beach. In fact, the study did not consider groundwater discharge as a potential source, since they measured illness at that point on the beach on days when there was not overland flow. An adjacent fresh-water source, either stormwater urban flow or groundwater, would have to move through the sand of the beach to provide bacteria to the swimmers. Also see response to peer review comments on Attachment #3, bacteria in groundwater.
		Against: Heal the Bay	235	

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60	Progressive cleanup of bacteria is underway	For: City Colony Plaza Latham & Watkins	158 262 470	<p>It is not clear what "cleanup" the commenter is referring to. Board staff is aware that the stormwater containment structure began construction in September, 2009, and while permitting and upgrade activities have been described, the City has provided minimal documentation of load reductions nor has the surface water quality impact of those changes been calculated using simple technical methods.</p> <p>Specifically, the City's actions upgrading OWDSs between 2005 and 2007 constitutes an upgrade of about 80 of the 400 residential septic systems and 8 of the 40 commercial OWDSs within the Civic Center area. Since the sewage flow ratio of residential versus commercial estimated by the City is roughly equal, the residential change would constitute about 20% reduction in residential waste and about 20% of reduction in commercial waste, or 20% of the total waste from OWDSs. This difference is small to explain, alone, the reduction in enterococcus measures on the beach, which Board staff attributes to reduced transport of bacteria due to reduced groundwater flows. In addition, the upgraded OWDSs have shown poor performance and effluent violations which could increase the potential discharge of waste: the actual reduction of wastes would be lower than 20%.</p>
		Against: Heal the Bay Baykeeper Surfrider Foundation	235 213-216 241	
61	Tech Memo #3 does not include sufficient statistical support	For: City	162	<p>Tech Memo #3 concludes that the published and peer-reviewed scientific information on the issue provides a sufficient basis for regulatory action. Three independent peer reviews agree. An earlier July 31, 2009, version of Tech Memo #3 did include original research. That study of summer bacteria at all Santa Monica Bay beaches used a statistical analysis to demonstrate that the frequency of enterococcus bacteria on beaches between 2005 and 2008 was best predicted by the presence or absence of adjacent septic system, as opposed to other factors such as watershed size or number of bathers. Early technical reviewers requested more information on the analysis and revisions were made to provide clarification. Also, see response to peer reviewer about statistical assessment.</p>
		Against: Heal the Bay Baykeeper	235 213-216	
62	The major shortcoming of the analysis done by the LARWQCB is the fact that they ignored published hydrologic data and analyses (groundwater level data, lagoon stage, ocean stage, water level maps and modeling analyses) that show the capture zone for Malibu Lagoon. Several examples of the relevant documentation that was not considered in the LARWQCB's analyses are included in Appendix 3-1.	City Colony Plaza	158,159, 162 263	<p>Staff finds it inappropriate to pre-judge conclusions from studies that are not complete. However, to the extent that results and preliminary findings were made available, staff considered such information.</p> <p>The City of Malibu first released to staff the hydrology information and interpretation described in Appendix 3-1 with their October 8 comments letter, so staff was not able to include the information in Tech Memo #3. Staff has asked for interim reports about the hydrology study since April 2008. The City has invited staff to hear an interim report on the groundwater study on November 3 or 4th when the hydrology study principals would all be in town.</p>

October 30, 2009

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63	Section 3 results end-of-pipe data. Sufficient explanation of these data is not provided. On what dates were the measurement taken?....Also these data are not relevant to.....1. concentrations of indicator bacteria that are reaching the water table....2. concentrations of indicator bacteria that reach the beaches.	City	157	Staff agrees. Brief end-of-pipe data was included to document that enterococcus bacteria are produced by OWDSs when no disinfection is present. The figures and text have been modified to reflect the comment (TM3-4).
64	Section 3 results-Bacteria in Groundwater- Figures 2 and 3 show single sample results but compare them to recreational water geometric means.	City	157	Geometric means are applicable to single sample results when multiple samples have not been collected. The City of Malibu's plots of geometric means are incorrect, as they combine values collected within a very large time period. The geometric mean was not intended to allow the averaging of all samples taken, as is apparently used in the displays provided by the City.
65	Data are from Stone's 2004 risk assessment report. The LARWQCB provides no documentation to infer that these wells represent the current groundwater quality conditions.	City	157	Staff identifies the data as collected in 2004.
66	Figure 3 Page T3-5 shows a plot of maximum enterococcus bacteria results from 27 surviving wells in the CC area.the Board's use of maximum frequently means one reading out of 5 years worth of data for moths of the wells, and/or fails to account for a management system whereby OWDS repairs made in 2004 or 2005 result in consistent values well below action levels.	City	157	The data is identified as maximum and is intended to show the prevalence with which the groundwater limits are exceeded in the sample period between 2004 and 2008. If OWDSs have been repaired such that adjacent groundwater is not impacted, this information should be documented and provided by the City of Malibu.
67	Section 3 Results: Bacteria in surface water- The statement "Malibu Civic Center groundwater discharge is a possible source of increased levels of enterococcus in the Lagoon" is misleading because groundwater monitoring has shown that not all the groundwater in the civic center area flow into the lagoon.	City	157	Stone (2004) stated that the majority of the groundwater from the Civic Center entered the lagoon and the majority of that water entered the ocean.
68	Table 2 labels the Mc-1,2 and 3 points, which seem to be different (inverted)	City	158	Typographical errors have been corrected.

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69	Table 2 shows a site SMB-12 which is not shown in figures 4. Where is it?	City	158	A full description of the site is included in the attachment and in the referenced document CSMP. SMB-12 is Sweetwater Canyon on Carbon Beach.
70	Technical accuracy of figures is questioned.	City	158-159	<p>Each figure was inspected again. Only one error was found, where the values in the figure showing cumulative exceedances on beaches did include double counted values. This administrative error has been corrected: enterococcus measures above 35 MPN/100mL but not above 104 MPN/100mL are now counted once (Figure 6, TM 3-10).</p> <p>The values in Figure 6 include non-detect values.</p> <p>The enterococcus exceedance numbers for 2005 are highest and lowest for 2007. Using 2006 values, where only one year is given, was considered to be the least biased representation of the data.</p>
71	Coefficient correlations do not show beaches have consistent bacteria.	City	158	<p>Staff agrees that more clarity of the use of correlation coefficients can be provided and has made changes in the text accordingly.</p> <p>See peer review concurrence that frequency plots and correlation coefficients are technically defensible.</p> <p>Staff considered stormwater and urban runoff as likely sources and thus selected a beach study period which minimized contributions from these sources. Other non-human sources are present at all beaches and did not provide sufficient dilution of human-specific enterococcus to affect the results of the Hiale et al. (1999) epidemiology study which found correlated highly credible gastrointestinal illness rates of 14 to 35 MPN/100 mL enterococcus, within the range quoted in the 1983 EPA criteria.</p> <p>The frequency intervals closely approximate log intervals, but do extend the ranges above 50 to emphasize the observed differences between septic and sewered beaches. The use of figures which are able to depict relationships observed is a desirable technical method.</p> <p>See response to peer reviewer comments Attachment #1 on statistics.</p>

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72	"Malibu beaches have more exceedances" and incorrect reference of number of illnesses at Surfrider.	City	158	<p>The statement that Malibu beaches exceeded the other two study areas referred to the study period 2005 to 2008. During 1995, when the data was collected for the Haile et al. study, Will Rogers beach did not have a low flow diversion to prevent overland flows from reaching the ocean. The relative enterococcus exceedances for the summer of 1995 are similar.</p> <p>The illness rates presented are identical for each beach on each day when enterococcus levels exceeded the water quality standards of 35 MPN/100 mL or 104 MPN/100mL. The number of illness predicted for each beach was similar in 1995.</p>
73	TMDL reference does not identify OWDSs as a source	City	161	<p>The Santa Monica Bay bacteria TMDL discussion includes OWDSs as a possible non-point source for beach bacteria. The Malibu Creek and Lagoon TMDL quantifies OWDSs as a source of bacteria and the Malibu Creek and Lagoon nutrient TMDL also quantifies effluent contributions from this source.</p> <p>All available references were reviewed.</p> <p>City of Malibu's Stone (2004) study limits risk from bacteria pollution to the area identified in the hydrology study as within 6 month travel time. LARQWCB used this interpretation to craft an MOU dictating the area where OWDSs would be upgraded, a task now 10% complete after 5 years.</p>
74	No historic findings are conclusive	City	161	Staff disagrees. Historic findings need not provide a conclusive link between OWDSs and the beach in the Civic Center area to provide substantial and persuasive evidence sufficient to convince Board staff and three independent peer reviewers that such a link exists.
75	Cross section poor [Figure 11, TM 3-28]	City	162	The cross-section includes references and is constructed according to standard methods. See additional discussion in letter in response to peer reviews.
76	The prohibition on the discharge of surplus recycled water from the Tapia Water Reclamation Facility in 1997 has not resulted in reduced bacteria levels at Surfrider Beach in the years since the adoption of prohibition. On the contrary, the number of days exceeding 1,000 CFU of total coliform bacteria have increased since then.	Las Virgenes MWD	206	Acknowledged.

Attachment #1

Comment: Interpretation of temporal and spatial groundwater information is lacking and a critical factor

Staff concurs that the groundwater system was not evaluated in Tech Memo #3. The City of Malibu's Stone Environmental Inc. (2004) did a sufficient job of demonstrating that the groundwater flow system underling the Civic Center area is in hydraulic connection with the beaches. That report says more than half of the groundwater comes from OWDSs and almost all of that water eventually finds its way to the ocean.

Detailed study of groundwater elevations is not expected to provide critical evidence linking OWDSs to the beach.

Staff concurs that evaluation of the groundwater system would be beneficial to a full understanding of the transport of bacteria to the beaches, the goal behind Board staff's request to the City of Malibu in January 2008 to complete additional hydrological studies on critical conditions. Staff commented during the development of the new study, a repetition of the Stone's 2004 study extended to include 2008 data; the model design would not be able to provide the assurance that groundwater surfacing did not occur on land or the beach during the wettest days. The new study continues to look at average conditions obscuring periods when the percolation rates are exceeded by influent ground or surface flow, and did not include data collected during the wettest periods when the groundwater is observed to pond uphill from Pacific Coast Highway. City's hydrological study also assumes at uniform boundary conditions inconsistent with the pending Izbicki's work (2009) and published Boehm's studies (Boehm et al., 2004) where groundwater discharge rates are variable.

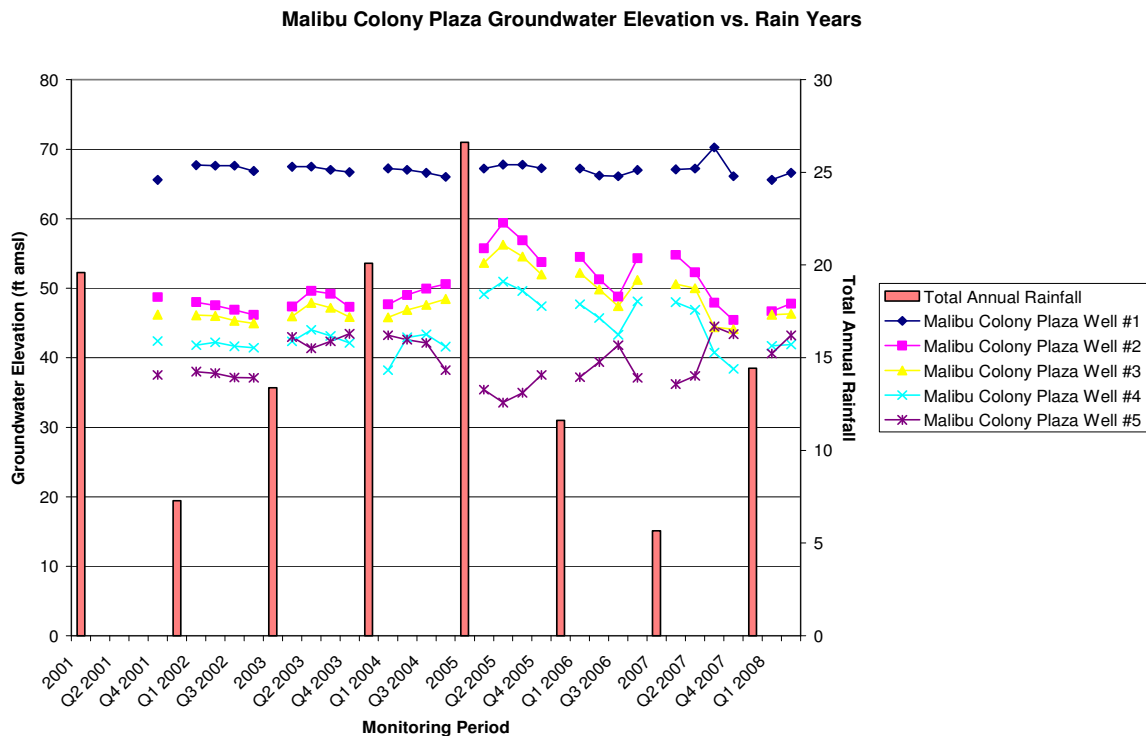
Early technical reviewers requested that staff discuss groundwater level variations and enterococcus concentrations of the very limited data set in the Civic Center area to further validate the study conclusion relating the two. Groundwater data was not available to identify bacteria and water level trends for the vicinity of most Santa Monica Bay beaches although a study of this type is needed to confirm the physical processes.

The scientific understanding of groundwater transport of pathogenic particles is less advanced than that for surface water transport of bacteria and viruses or for groundwater transport of dissolved or uniformly distributed fluids. Steady state models have been used in the Malibu Civic Center area to predict the movement of water or dissolved pollutants, but the models assume that fluid movement is continuous, along a single path and a function of physical fluid properties.

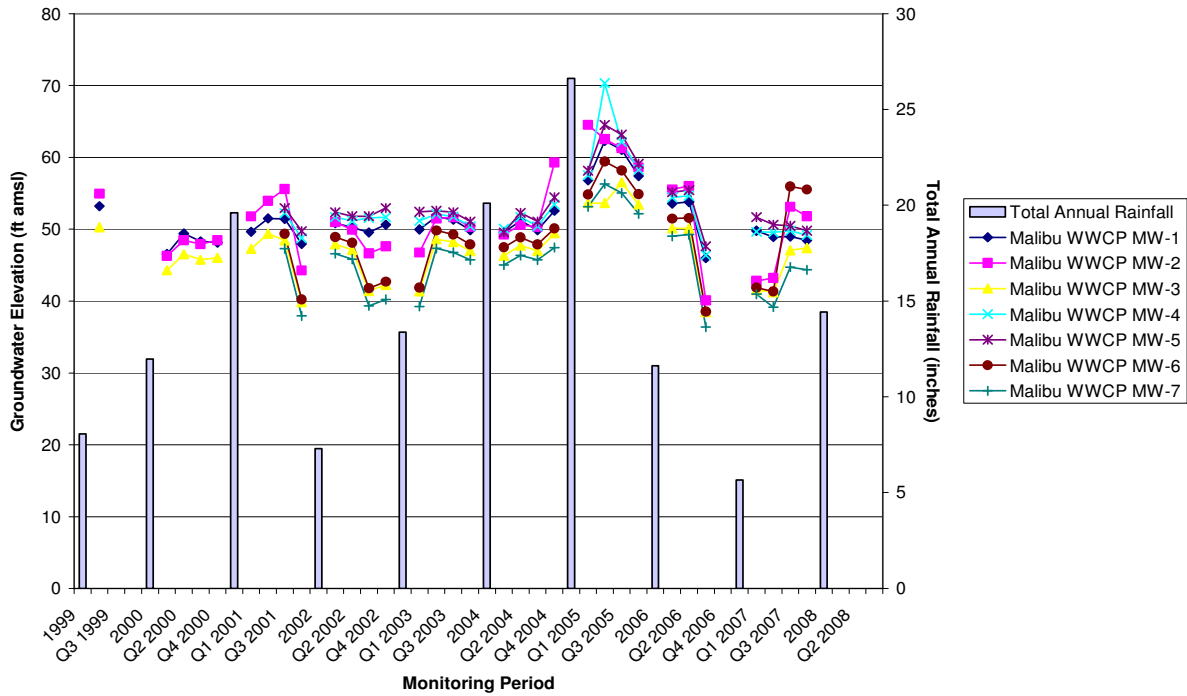
Emerging research shows that bacterial, viral, and organic particles' transport is not uniform and transport is known to vary with nutrients, time, season, tide, tortuosity of the transport path, organic materials, and even biological predation. Most models focus on dissolved pollutants. Most dissolved pollutants seek to disperse uniformly through an aquifer by diffusion, where as organic particles may become 'caked' in the soil through the processes of adhesion. As a result, the absence of bacteria or viruses in the groundwater at a specific location and time can be over-interpreted.

Groundwater and enterococcus measures found in the Civic Center area, alone, present a complex picture subject to alterative interpretations. The charts below show enterococcus densities, groundwater elevation in monitoring wells in the Malibu Civic Center and annual rainfall. Staff provides an interpretation although the data sets are not large enough for the use of statistics to quantify the strength of those correlations. The

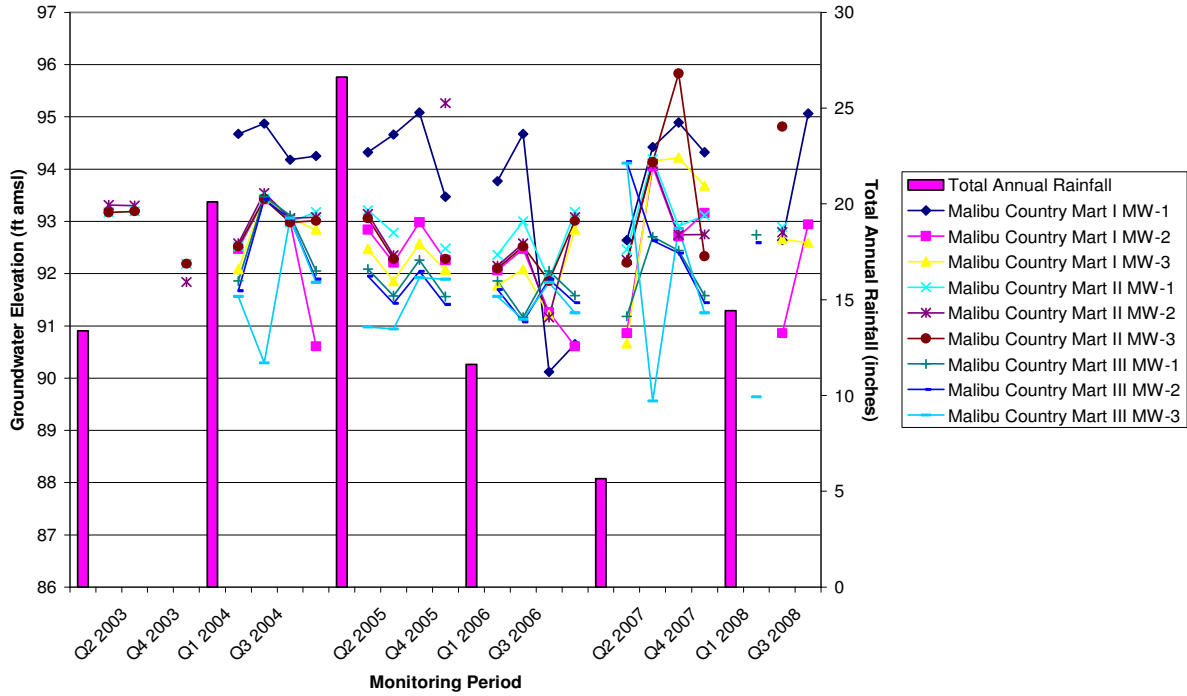
wells are located (a) in Winter Canyon at Malibu Colony Plaza and Malibu WWCP and (b) Malibu Country Marts 1, 2 and 3 near to the receiving waters of Malibu Creek. The wells in (a) show more systematic variation in groundwater level with rainfall than the wells in (b).



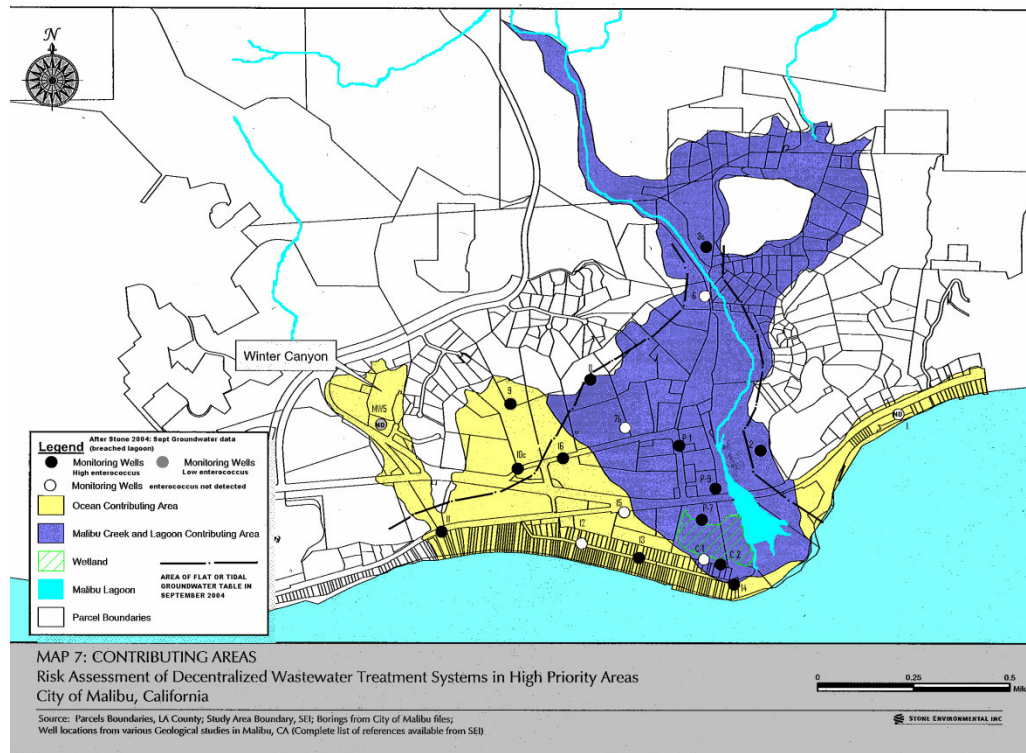
Malibu WWCP Groundwater Elevation vs. Rain Years



Malibu Country Mart I-III Groundwater Elevation vs. Rain Years



The map below shows Civic Center wells and those wells where enterococcus varied with rainfall are found outside the broken line. Groundwater levels do not vary in the wells in the center of the basin (except for tidal effects). The only wells with no detectable enterococcus in September 2004 are also found in the area with constant groundwater levels.



The simplest interpretation of these groundwater observations is that enterococcus movement in the subsurface is not via uniform dispersal but episodic transport. The lack of detections in the center of the Civic Center may be caused by preferential pathways of fluid transport as opposed to the absence of uniform bacteria density. The groundwater observations are not found to conflict with the study findings, but additional work is necessary to document the nature of bacteria transport in groundwater and the episodic nature of freshwater discharge through the aquifer in the Civic Center area.

A hydrological connection is more likely if the water table is shallow. Further evidence of a transport path for bacteria in the Civic Center beaches is shown in these charts where the water table is calculated to occur 4 to 5 feet below (see highlights) the base of the leachfield, assumed to exist at 1 foot. Groundwater elevations calculated to be less than 6 feet are also highlighted and observed a total of 24 times at these 5 wells with quarterly sampling between 2002 and 2008.

Malibu Creek Plaza (MW-1)	Surface to Groundwater Elevation	Enterococcus	Malibu Creek Plaza (MW-4)	Surface to Groundwater Elevation	Enterococcus
Unit	ft	(MPN/100 ml)	Unit	ft	(MPN/100 ml)
7/12/2002		7.4	7/12/2002		49.6
9/5/2002		8.4	9/5/2002		22
11/6/2002		4.1	11/6/2002		8.2
3/12/2004	8.93	20.2	3/12/2004	8.11	48.7
5/28/2004	5.33	344.8	5/28/2004	4.67	1
8/13/2004	6.75	15.3	8/13/2004	6.07	3
11/12/2004	7.84	1	11/12/2004	7.88	1
2/15/2005	9.6	231.8	2/15/2005	8.55	2
5/1/2005	4.53	1	5/1/2005	6.92	1
9/1/2005	5.6	4.1	9/1/2005	5.2	1
11/22/2005	8.8	7.4	11/22/2005	8.14	2
2/15/2006	8.38	1	3/2/2006	7.7	1
5/3/2006	8.8	1	5/3/2006	8	2
8/22/2006	5.7	1	8/22/2006	5.1	1
11/15/2006	5.47	6.2	11/15/2006	4.9	15.6
2/13/2007	8.31	11.6	2/15/2007	8.76	1046.2
5/11/2007	6.53	1	5/11/2007	5.4	4.1
8/18/2007	7.07	42.4	8/17/2007	5.89	1
11/7/2007	7.74	1	12/6/2007	6.67	1
2/14/2008	8.78	84.5	2/14/2008	7.19	2419.2
5/13/2008	8.02	50.5	5/13/2008	6.72	2419.2
8/26/2008	6.71	9.8	8/26/2008	5.65	25.4
11/18/2008	6.24	7.2	11/18/2008	5.07	7.1

Malibu Creek Plaza (MW-2)	Surface to Groundwater Elevation	Enterococcus	Malibu Creek Plaza (MW-1)	Surface to Groundwater Elevation	Enterococcus
Unit	ft	(MPN/100ml)	Unit	ft	(MPN/100ml)
7/12/2002		2419.2	7/12/2002		7.4
9/5/2002		4.1	9/5/2002		8.4
11/6/2002		51.9	11/6/2002		4.1
3/12/2004	7.35	1	3/12/2004	8.93	20.2
5/28/2004	4.05	10.8	5/28/2004	5.33	344.8
8/13/2004	5.45	98.1	8/13/2004	6.75	15.3
11/12/2004	7.05	31.8	11/12/2004	7.84	1
2/15/2005	8.25	866.4	2/15/2005	9.6	231.8
5/1/2005	6.27	64.5	5/1/2005	4.53	1
9/1/2005	5	214.3	9/1/2005	5.6	4.1
11/22/2005	7.45	1	11/22/2005	8.8	7.4
3/2/2006	7.2	1	2/15/2006	8.38	1
5/3/2006	7.3	18.3	5/3/2006	8.8	1
8/22/2006	4.47	1	8/22/2006	5.7	1
11/15/2006	4.27	1	11/15/2006	5.47	6.2
2/13/2007	6.8	32.9	2/13/2007	8.31	11.6
5/11/2007	5.29	1	5/11/2007	6.53	1
8/18/2007	5.74	10.8	8/18/2007	7.07	42.4
11/7/2006	6.38	5.2	11/7/2007	7.74	1
2/13/2008	7.43	3	2/14/2008	8.78	84.5
5/13/2008	6.6	3	5/13/2008	8.02	50.5
8/26/2008	5.57	9.7	8/26/2008	6.71	9.8
11/18/2008	5	1	11/18/2008	6.24	7.2

Malibu Country Mart 3 (MW-3)	Groundwater Elevation	Surface Elevation	Surface to Groundwater Separation	Enterococcus
Unit	ft	ft	ft	(MPN/100ml)
3/8/2004	91.56	98.86	7.3	0
7/9/2004	90.29	98.86	8.57	0
9/23/2004	93.06	98.86	5.8	0.99
12/14/2004	91.83	98.86	7.03	13
3/15/2005	90.98	98.86	7.88	0
6/15/2005	90.94	98.86	7.92	1860
9/16/2005	91.92	98.86	6.94	0
3/20/2006	91.89	98.86	6.97	0
6/21/2006	91.56	98.86	7.3	97
9/13/2006	91.12	98.86	7.74	0
12/27/2006	91.83	98.86	7.03	23
3/20/2007	91.25	98.86	7.61	0
6/13/2007	94.11	98.86	4.75	0
9/14/2007	89.56	98.86	9.3	0
12/21/2007	92.86	98.86	6	0
4/4/2008	91.25	98.86	7.61	0
7/2/2008	89.64	98.86	9.22	0

Malibu Country Mart 1 MW-2	Groundwater Elevation	Surface Elevation	Surface to Groundwater Elevation	Enterococcus
Unit	ft	Ft	Ft	(MPN/100ml)
12/14/2004	90.61	98.16	7.55	17
3/15/2005	92.84	98.16	5.32	0
6/15/2005	92.21	98.16	5.95	120
9/15/2005	92.98	98.16	5.18	0
12/14/2005	92.26	98.16	5.9	0
3/20/2006	92.06	98.16	6.1	0
6/21/2006	92.47	98.16	5.69	52
9/13/2006	91.26	98.16	6.9	0
12/27/2006	90.61	98.16	7.55	0
3/20/2007	90.86	98.16	7.3	0
6/13/2007	94.05	98.16	4.11	0
9/14/2007	92.71	98.16	5.45	0
12/21/2007	93.16	98.16	5	0
4/4/2008	90.86	98.16	7.3	0
7/2/2008	92.94	98.16	5.22	0

Malibu Country Mart MW-1	Groundwater Elevation	Surface Elevation	Surface to Groundwater Elevation	Enterococcus
Unit	ft	Ft	ft	(MPN/100ml)
MCL	0	0	0	
Sample Date				
12/14/2004	94.25	98.87	4.62	0
3/15/2005	94.32	98.87	4.55	0
6/15/2005	94.66	98.87	4.21	3880
9/15/2005	95.08	98.87	3.79	0
12/14/2005	93.47	98.87	5.4	0
3/20/2006	93.77	98.87	5.1	0
6/21/2006	94.67	98.87	4.2	10
9/13/2006	90.12	98.87	8.75	0
12/27/2006	90.65	98.87	8.22	0
3/20/2007	92.64	98.87	6.23	0
6/13/2007	94.42	98.87	4.45	0
9/14/2007	94.89	98.87	3.98	0
12/21/2007	94.32	98.87	4.55	0
4/4/2008	92.64	98.87	6.23	0
7/2/2008	95.06	98.87	3.81	0

Attachment #2

Comment: Selection of Study Method was flawed.

Multivariate analysis was beyond the scope of this study, which relied primarily on exceedance measures. Where multiple variables were present, the power of the statistical analysis was not high enough to allow meaningful interpretation of smaller data sets, even if previous workers have used such analysis.

Staff provides a comment on each of the factors raised, but notes that the data set associated with each factor on Civic Center beaches is insufficient to provide a statistically valid measure of the factor's impact after 4 years of weekly sampling.

Statistical tools beyond student t-test or Chi square test were used, as discussed in the response to peer review. An example of the limitations of smaller data sets was requested by reviewers and is offered here. Malibu Colony is an OWDS beach, with many physical properties like Manhattan Beach Strand, which is a sewer beach. Data sets for the two beaches for 2006 are provided below. While a direct comparison is desirable, simple statistical measures did not provide clear conclusions as shown in the table below.

[illegible]

Staff responds on each of several confounding factors identified by commenters.

Bird/Avian populations are not considered to be a confounding factor. See peer review response Attachment #2.

Staff's work in Technical Memo #3 identified non-human sources of stormwater/urban runoff and natural beach bacteria. This confirmed the findings of Griffith, Schiff and Lyon in 2006 (SCCWRP) that non-OWDS bacteria sources in stormwater/urban flow supply enterococcus to the beaches, although little is delivered during dry summer days. Griffith and others also found that non-human sources of enterococcus are also found on beaches. These non-human natural beach bacteria are the enterococcus found on both OWDS and sewered beaches, under all conditions that do not result in statistically significant differences between the beaches.

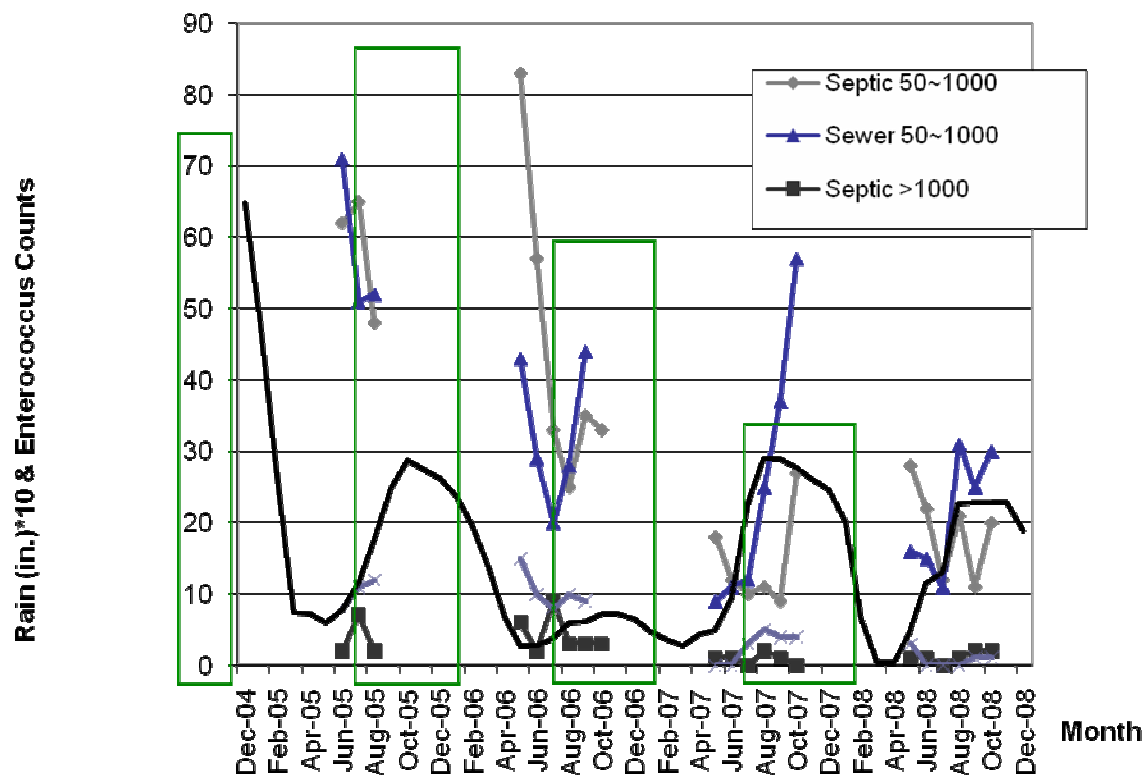
Staff also looked at the variation in enterococcus densities by month and year for OWDS and sewered beaches to provide a response, but notes that these observations are not supported by a measure of statistical significance.

Monthly bacteria data from sewered and OWDS beaches are presented in the figure below. The chart shows a rolling average of rainfall in inches, plotted with the number of enterococcus measures within the intervals given in MPN/100 mL for sewered and OWDS beaches against the sample date. As an example, OWDS beaches contained more than 70 enterococcus density measurements between 50 and 1000 MPN/100mL in June of 2005. The boxes outline the summer dates during which the enterococcus densities on the beaches were measured.

The chart shows that enterococcus densities between 50 and 1000 MPN/100mL are highest on both sewered and OWDS beaches in the early part of the summer and the late part of the summer, consistent with wet summer days discussed by Griffith et al. (2006). The enterococcus measures in these interval densities become less frequent following drier winters. Enterococcus densities above 1000 MPN/100 mL are seen to remain constant and measures below 50 MPN/100mL were consistently high, varied as a function of the sample size, and are not shown. The results are most simply explained by the existing hypotheses that stormwater/urban runoff causes variations in the enterococcus densities when rain events occur, especially at the beginning and end of the summer. Natural bacteria sources do supply enterococcus at densities below 50 MPN/100 mL and above 1000 MPN/100 mL on all beaches, as demonstrated in the limited variations seen in the larger measures and the persistence of the smaller measures. However, another enterococcus source or transport path must be present to explain why enterococcus densities between 50 and 1000 MPN/100mL vary more and do not go to zero when rainstorms are absent and transport across the beach berm is also absent.

Staff comments that this more detailed monthly analysis of 57 beaches does not provide a clearer understanding of the variations in enterococcus on the beaches.

Santa Monica Bay Beaches: Rain at LA International Airport versus Enterococcus Counts in Interval Frequency by Month



The Santa Monica Bay bacteria TMDL demonstrated a link between rainfall and fecal indicator bacteria during wet weather and even for wet summer weather. Griffith and others, who completed the 2006 bacteria study upon which the TMDLs are based, did not investigate groundwater enterococcus sources, attributing correlations in bacteria density on beaches with berms to winter bird populations. However, they did not attribute all enterococcus to birds.

“It appears that factors other than flow may be responsible for water quality exceedances at reference beaches with intact sand berms when storms are insufficient to breach berms. For example, San Mateo Creek never breached its sand berm during the sampling period, yet this reference beach had a similar frequency of bacterial water quality threshold exceedances as those of adjacent San Onofre Creek when its sand berm was breached. A possible reason for the many exceedances observed at this non-breached site was the large number of Western Gulls observed feeding on the beach during wet weather sampling (page 7).”

A simpler conclusion consistent with the results presented in Technical Memo #3 is that bacteria moved in stormwater through the beach berm.

To examine a bird source for enterococcus exceedances during dry summer months, bird counts were obtained for Zuma beach in 2003 and Malibu Lagoon in 2004. The ten minute counts show that, during the

summer, the bird counts are roughly equivalent with 183 birds in June at Zuma and with 320 birds in June at Malibu Lagoon; with 417 birds in July at Zuma and 230 birds in July at Malibu Lagoon. However, Zuma beach has consistently lower enterococcus densities than Surfrider Beach. The small sample size of two beaches limits the strength of this argument, just as it does in the 2006 SCCWRP study.

Storm or storm tides might affect the volume of groundwater discharge containing septic bacteria. However, the analysis focused on summer samples when storms and storm tides are less frequent. Based on De Seyes, the impact of elevated sea level would be to temporarily decrease the impact of human waste, meaning that if a storm is a confounding factor it would result in the under measurement of enterococcus and temporarily diminish the apparent health risk. Further, watershed size does not correlate with summer mean enterococcus values, an indicator that sources other than storm and urban flows must be present. See response to peer review Attachment #1.

Human (transient) populations are not considered to be a significant confounding factor because the enterococcus frequencies are too consistent in summer samples between 2005 and 2008.

The closure or openness of the lagoon is not considered to be a confounding factor, because the lagoon remains closed during the summers most years between May and October.

See the comments received from Tapia WWTP concerning evidence that increased discharge from higher in the watershed does not increase the bacteria concentrations at Cold Creek.

Attachment #3

Comment: Wait for additional studies.

The City of La Canada-Flintridge proposed sewer assessment districts on four dates between 1998 and 2009, each of which show an increase in the total assessment per property as construction costs rise, the number of total participants drop when some connect to a sewer line, and the property available for construction becomes more limited (pers. com. LCF Public Works).

La Canada-Flintridge Sewer Engineering Design	1998	2002	2004	2009
Assessment District	1	2	3B and 3A	5 and 6
Total Assessment per Property (to be paid over 20 years)	\$8,300	\$12,000	\$18,200-\$22,200	\$50,000-\$100,000
Type	Gravity	Gravity	Gravity	Low-Pressure

Past studies have shown stormwater is a source of bacteria, and the City of Malibu is taking steps to address this problem with stormwater containment. However, this simple measure is not enough, based on existing science. The Los Angeles County Fire Department reports beach goers in Malibu in 2007 was 40,000 per month in the winter and 200,000 per month in the summer. Given winter exceedances and summer exceedance rates and the illness risk provided by Haile et al. (1999), summer beaches are associated with more than twice the number of illnesses expected on winter beaches. Even with more exceedance days in the winter, more illness will result from summer beach use.

Septic system implications based on Richard Ambrose's Bacteriorides study are overstated by the City because (1) bacteriorides fate and transport is poorly studied and may be more severely limited than other fecal-indicator-bacteria, (2) the study took place in a dry year when groundwater septage transport is expected to be minimal, (3) the relationship between human illness and bacteriorides, an indicator of human illness vectors, is unknown so the significance of the bacteria is unknown, and (4) enterococcus criteria took 3 years of beach studies and 5 to 10 years of study to develop and a bacteriorides criteria is unlikely to be finalized at the state and federal level within the time that the SMB bacteria TMDL requires a load reduction. Further, Dr. Ambrose agreed via email that he had not reached final conclusions based on his findings.

Septic system implications based on John Izbicki's study are overstated by the City because (1) groundwater discharge varies with the season and the number of sampling points, yet the study based on less than two weeks of data is less-completely studied and may be more severely limited than other fecal-indicator-bacteria, (2) the study took place in a dry year when groundwater septage transport is expected to be minimal, (3) the dynamic relationship between groundwater and tides, freshwater and saltwater, can best be understood through inspection of additional beaches beyond just Surfrider Beach and even a multi-year and multi-parameter study by Dr. Izbicki in Santa Barbara failed to quantify groundwater discharge at that beach, and (4) enterococcus criteria took 3 years of beach studies and 5 to 10 years of study to develop. A full understanding of groundwater impacts at Civic Center Beaches is unlikely to be finalized and peer

reviewed within the time that the SMB bacteria TMDL requires a load reduction. Further, Dr. Izbicki agreed via email that he had not reached final conclusions based on his findings.

Septic system implications based on Stone Environmental's new groundwater modeling are overstated by the city because (1) the accuracy of groundwater modeling varies with the number of sampling points, yet the study did not place equal weight on all the groundwater data available, (including that supplied by the Regional Board staff) and limited water elevation studies to a greatly limited set of wells, (2) the study emphasized water level changes in a dry year when groundwater septage transport is expected to be minimal, (3) the dynamic relationship between groundwater and tides, freshwater and saltwater, as documented by Dr. Izbicki in the more recent study above is not consistent with model assumptions of a steady state uniform groundwater discharge to the ocean, and (4) a full understanding of groundwater impacts at Civic Center beaches is unlikely to proceed from a second study by Stone, neither of which have been reviewed by an independent peer, making such an evaluations unlikely within the time that the SMB bacteria TMDL requires a load reduction. Further, the City agreed to participate with the Regional Board staff on the study, but did not respond to requests for update or information after April, 2008.

Septic system implications based on Donna Ferguson's and Steven Weisberg's SCCWRP Bacteria study in Ramirez Creek are overstated by the City because (1) bacteria levels were higher both upstream of Paradise Cove and the Beach in 2005 and 2006, and dry weather with lower surface flows is associated by all co-authors with the recent reduction in bacteria densities, (2) additional study is being delayed until a wet year, (3) no evidence has been developed which rules out a groundwater source for the bacteria despite opportunities offered by Board staff to sample wells and creek water during the dry summer in a search for such evidence, and (4) this is an entirely different watershed from the Civic Center. Further, Mr. Weisberg agreed that additional study of groundwater contributions to the bacteria in Ramirez Creek were necessary.

Septic system implications based on Steven Weisberg's SCCWRP epidemiology study of Surfrider Beach by SCCWRP is ongoing with fieldwork conducted during the summer of 2009 are overstated by the City because (1) bacterioides fate and transport is poorly studied and may be more severely limited than other fecal-indicator-bacteria, (2) the study took place in a dry year when groundwater septage transport is expected to be minimal, (3) the relationship between bacterioides or other physical factors measures at the beach and human illness is unknown so the preliminary significance of the presence or absence of those physical factors or human illness is unknown, and (4) enterococcus criteria took 3 years of beach studies and 5 to 10 years of study to develop and new epidemiology criteria for the Civic Center beaches alone is unlikely to be finalized at the state and federal level within the time that the SMB bacteria TMDL requires a load reduction.